

12025 - 12028

Drive Tube

41 cm

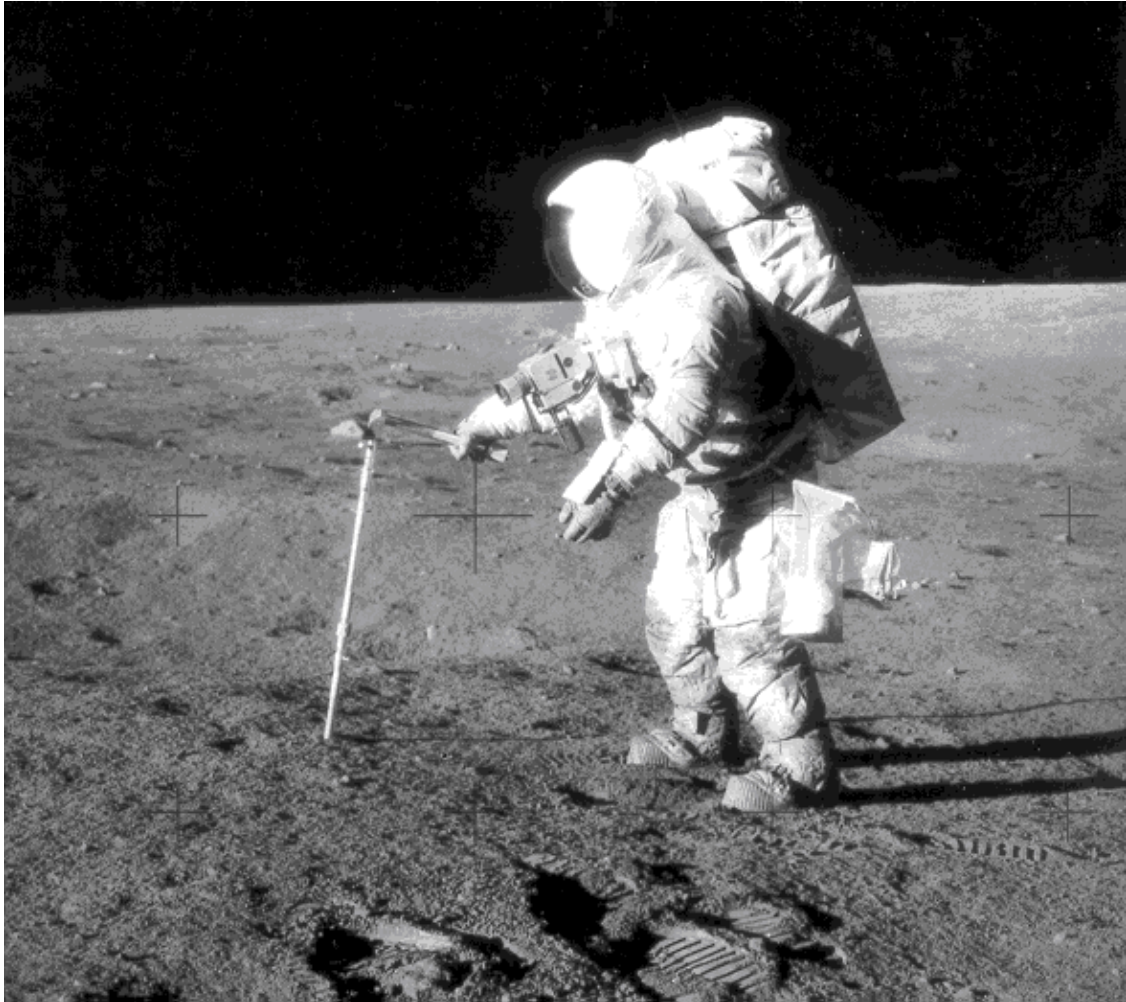


Figure 1: Astronaut caught in the process of hammering in the double drive tube at Halo Crater; Apollo 12 (with the side of his hammer!). "We've got a double. Now, the question is can we pull it out?" NASA AS12-49-7286.

Introduction

A core sample was obtained from about 30 meter from Halo Crater and 220 meters from Bench Crater, Apollo 12. The double drive tube was driven in 69 cm (figures 1 and 3), but only 41 cm of material was returned (figures 4 and 5). The bottom segment was completely full (12025 is the top segment and 12028 is the lower segment).

Petrography

12028 contains a coarse layer about 2 cm thick. It could simply be nothing more than a friable basalt

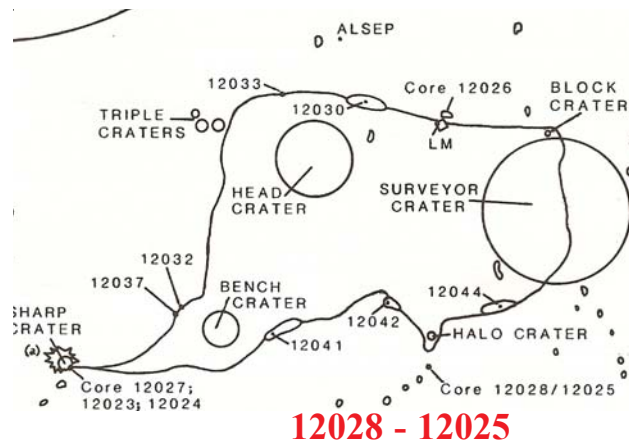


Figure 2: Map of Apollo 12 site., showing location of double drive tube.

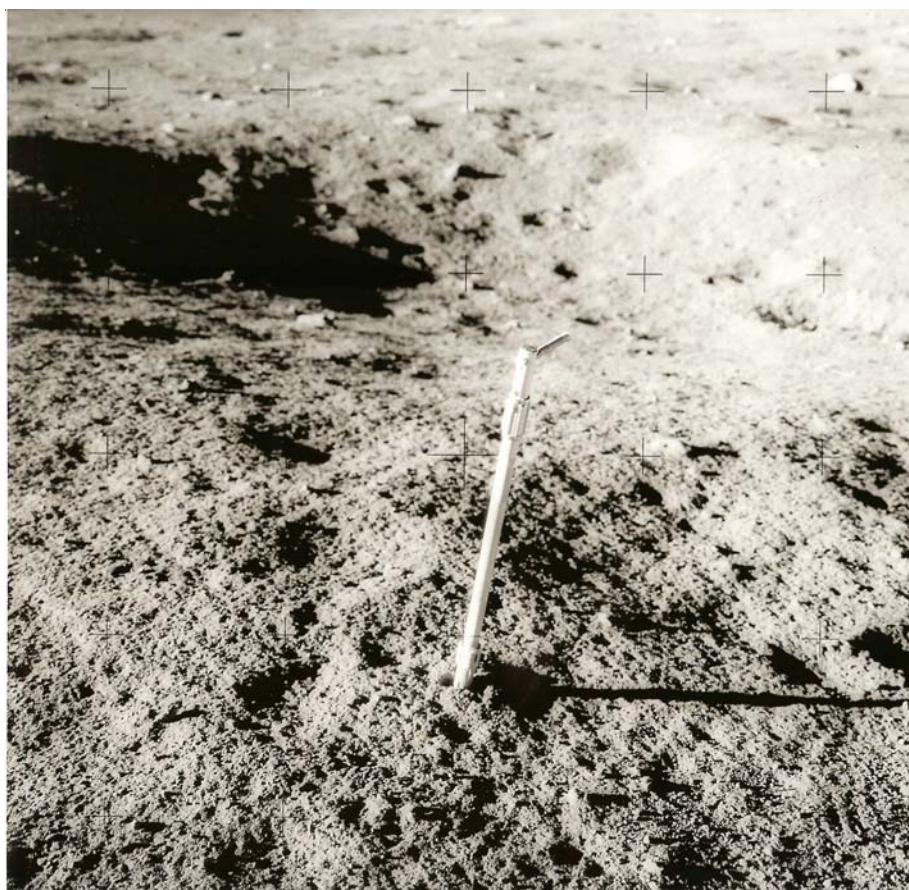


Figure 3: Photo of 12025-12028 double drive tube. AS12-49-7287.

fragment that broke up into mineral fragments as the core was driven through it (figure 6).

The maturity index of the Apollo 12 cores have not been reported by the I_s/FeO method, but can, perhaps be judged by average grain size (figure 4), agglutinate content (glazed aggregates), rare gas content (figure 6) or fossil nuclear tracks (figure 13). The average grain size varied from 64 to 125 microns along the length (figure 4). The 2 cm thick, coarse layer had an average grain size of 600 microns.

The mineralogical characteristics of the double drive tube were first reported by Seller et al. (1971), McKay et al. (1971) and Quaide et al. (1971).

The coarse layer is an olivine basalt typical of the Apollo 12 basalts (Sellers et al. 1971).

Chemistry

The double drive tube has not been analyzed for all elements (table 1). Since it was located between 12042 and 12044 (figure 2), the top portion (12025) should be compared with the analyses of these surface soil. Laul et al. (1971) have updated the original analyses

Mineralogical Mode

Sellers et al. 1971

depths	X	IX	VII	VI	V	IV	III-u	III-m	II	I
Glazed										
Aggregates	46	10	44	39		14	9	23	6	1
Glass	14	9	10	12	1	22	6	9	15	10
Breccia	3	21	0	2		5	7	5	26	31
Basalt	3	15	8	5		10	22	23	4	5
Anorthosite		2		1				5	1	1
Mineral	29	42	37	40	99	46	54	34	47	51
(see figure 5 for depths)										

Figure 4: Dissection diagram of double drive tube showing location of splits (LSPET 1970; Sellers et al. 1971).

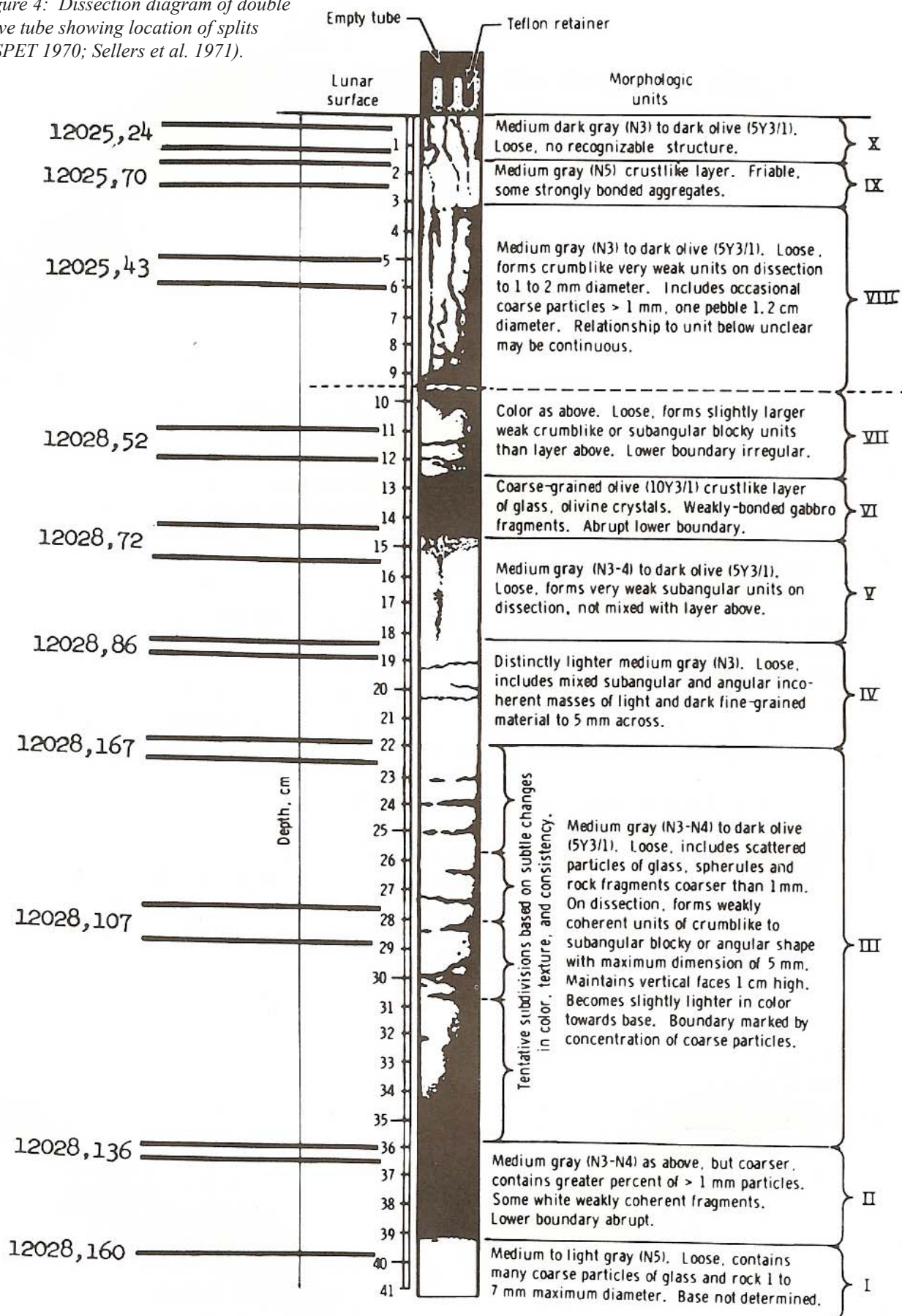
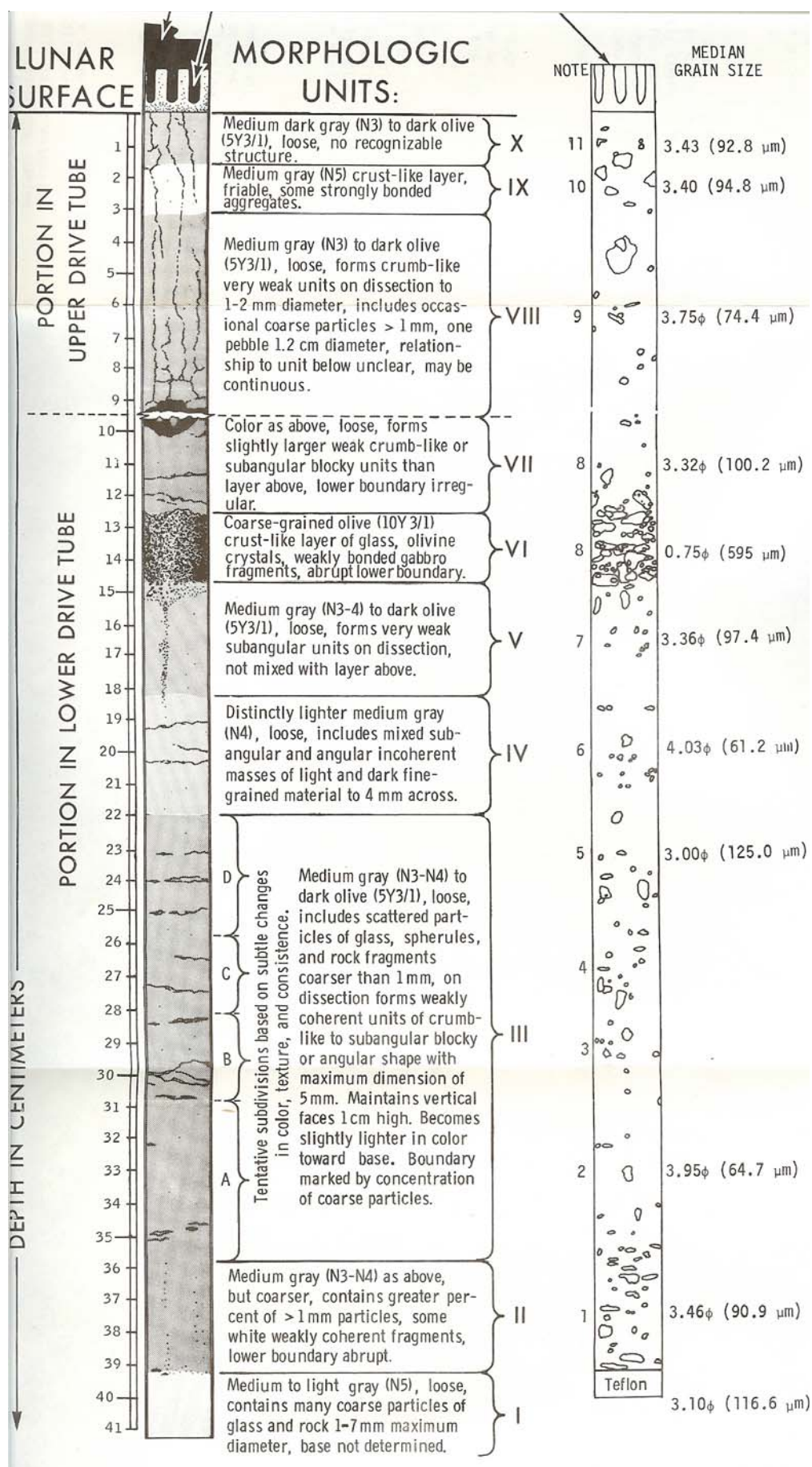


Figure 5: Dissection diagram from Lunar Core Catalog showing average grain size as function of depth (Duke 1974).



reported by Ganapathy et al. (1970). The REE content is quite high.

Cadogen et al. (1972) determined the carbon compounds as function of depth, but it is difficult to calculate the total carbon content from this. Moore et al. (1971) determined the carbon and nitrogen content of 9 splits. The carbon content was relatively constant at about 130 ppm, while the nitrogen content decreased from 130 ppm at the surface to about 90 ppm at depth.

Cosmogenic isotopes and exposure ages

Nishiizumi et al. (1979) studied the depth profile for ^{53}Mn for 12025-12028 and Rancitelli et al. (1971) reported ^{22}Na and ^{26}Al as function of depth (figure 11).

Other Studies

Arrhenius et al. (1971) reported large and irregular variations in the fraction of track-rich grains ranging from 0% to almost 100%. Comstock et al. (1971) determined the density of nuclear tracks as function of depth (figure 13).

Marti and Lugmair (1971) and Basford et al. (1973) determined the isotopes for Xe and Kr as function of depth (figure 6).

Hoyt et al. (1971) found that material from depth, emitted light when heated (figures 9 and 10).

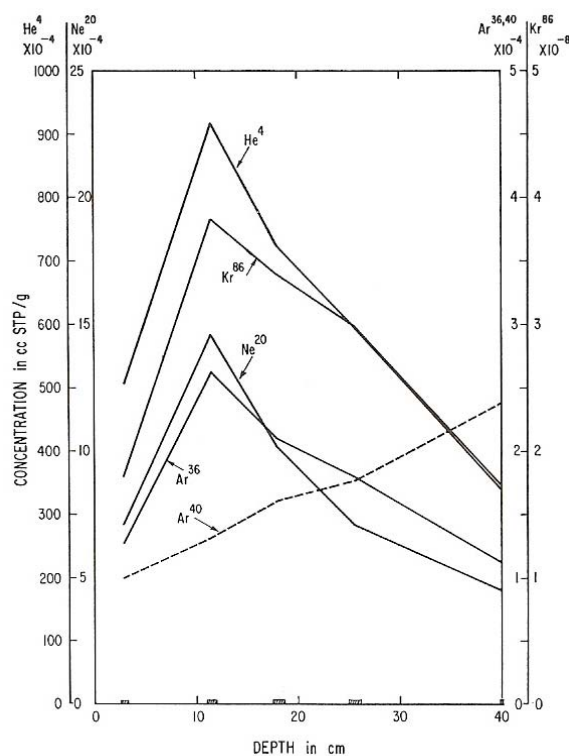


Figure 6: Summary of rare gas content of the Apollo 12 double drive tube, indicating maximum maturity at 10 - 12 cm depth (Marti et al. 1971).

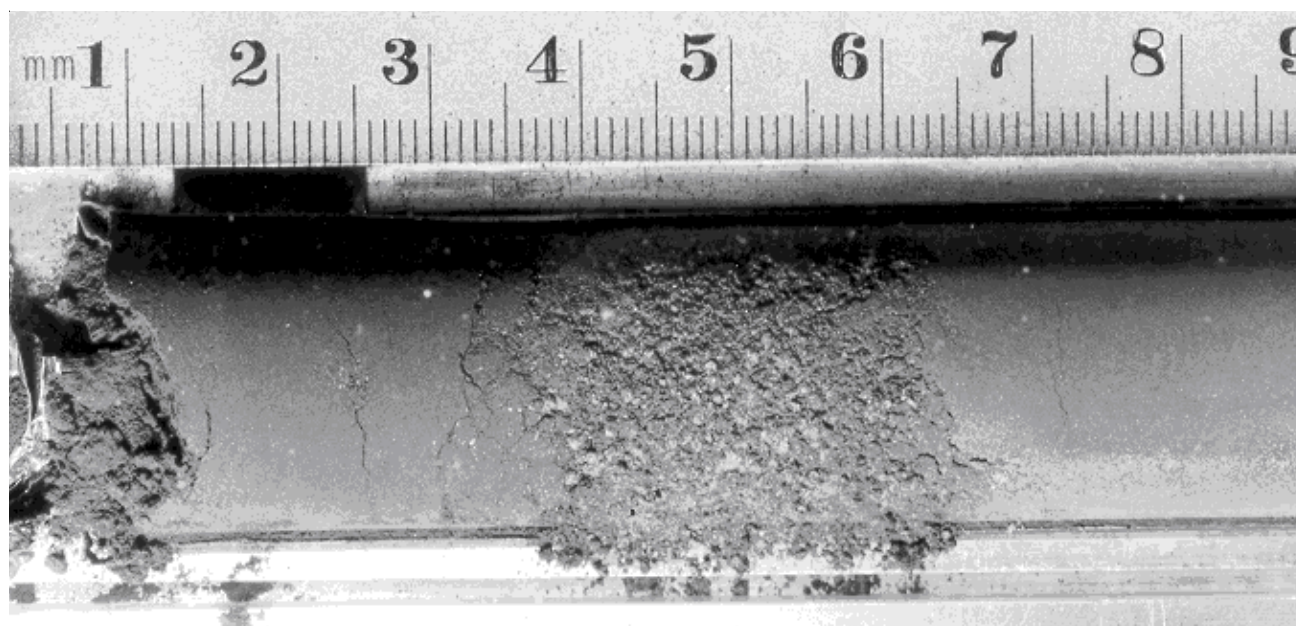


Figure 7: Photo of 2 cm thick coarse layer near top of 12028. NASA S69-23404. Scale in cm.



Figure 8: Close-up photo of dissection of 12025 (upper portion of double drive tube) showing isolation and removal of a large particle (1 cm) at 27 cm. NASA S 69-23806. Scale is in cm.

Processing

The Apollo 12 cores were 2 cm in diameter (Allton 1989). Please note that the Apollo 11 and 12 drive tubes did not cut into the regolith, but rather the regolith flowed thru the bits to fill the tubes as they were driven (often hammered) into the regolith – as such, the length of the cores does not match the depth into the regolith.

There are no thin sections for this core.

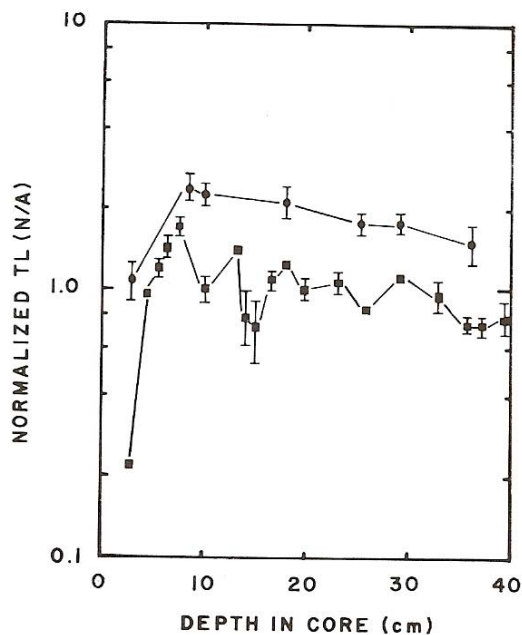


Figure 9: Thermal luminescence as function of depth in core (Hoyt et al. 1972).

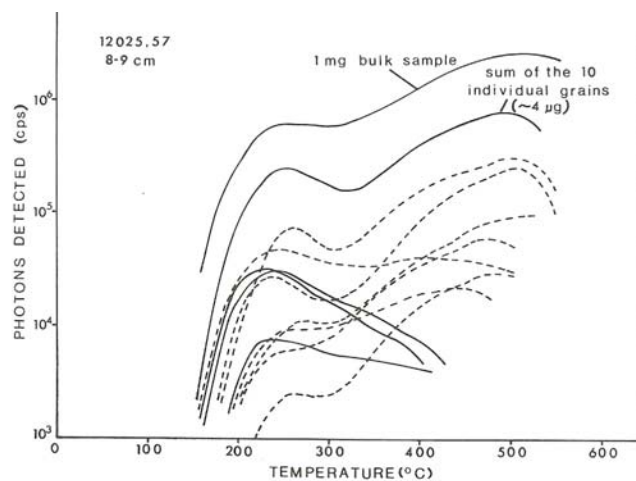


Figure 10: Luminescence of individual particles as function of temperature release (Hoyt et al. 1972).

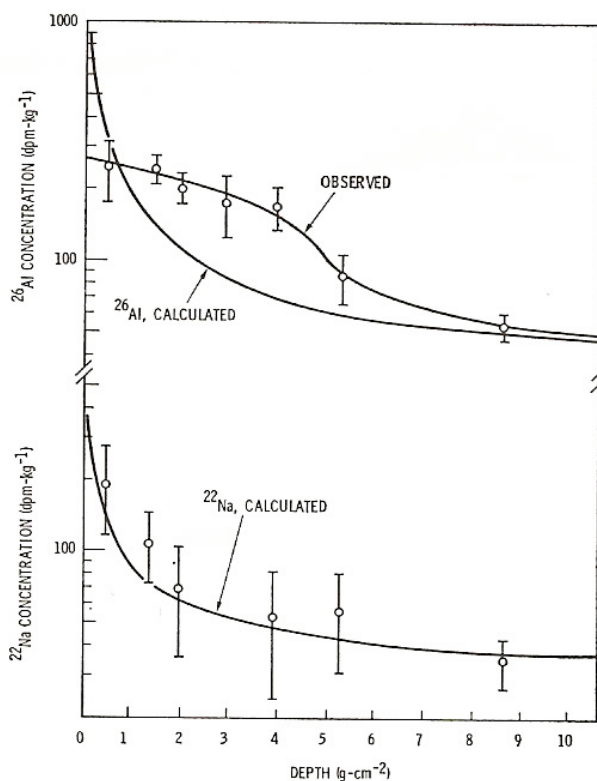


Figure 11: Cosmic-ray-induced activity as function of depth in core 12025 (Rancitelli et al. 1971, 1972).

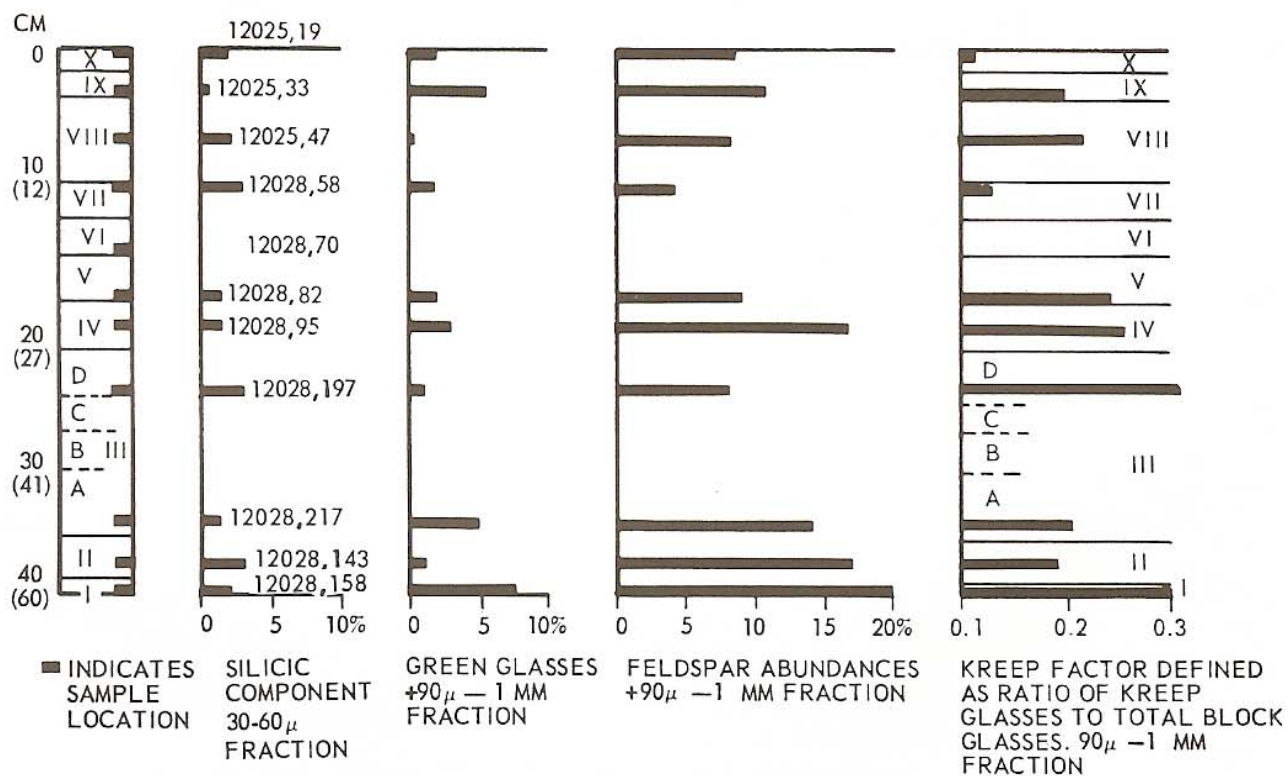
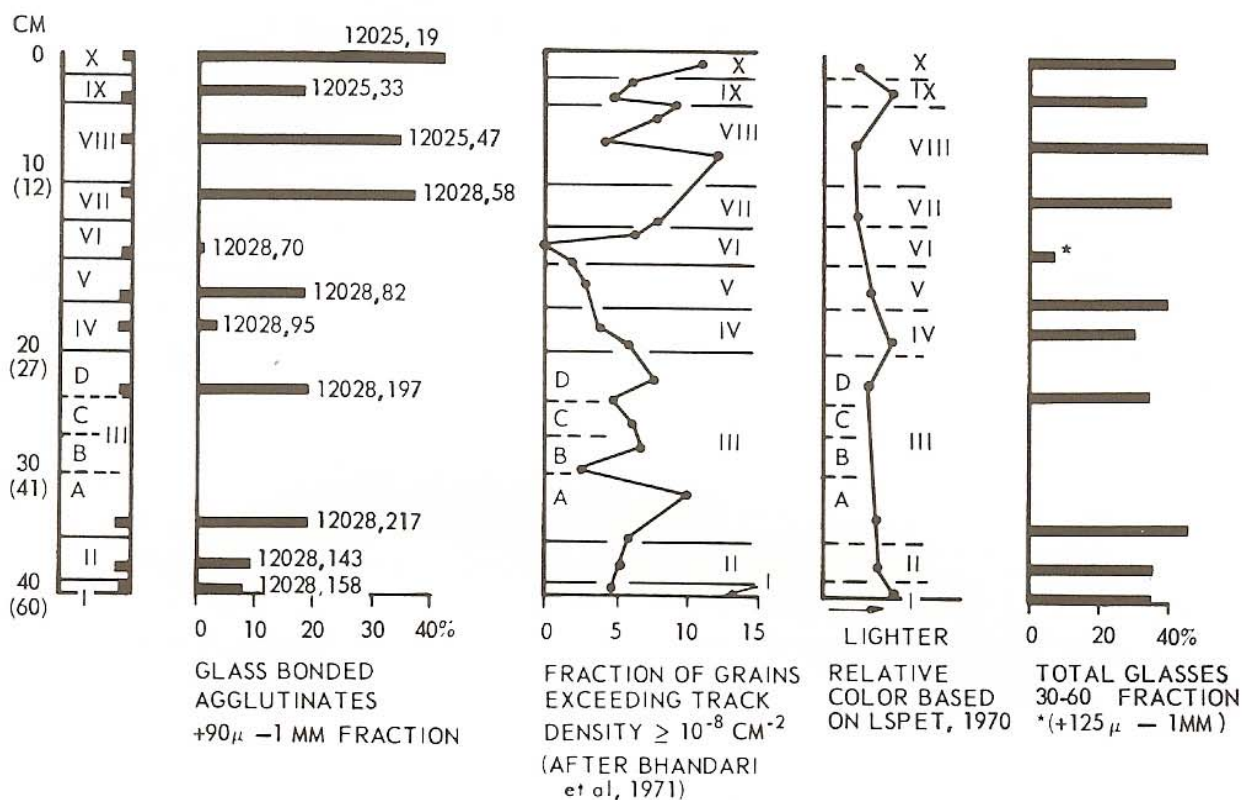


Figure 12: Variation of components in double drive tube (McKay et al. 1971).

Table 1. Chemical composition of 12028 - 25.

	12025	12028	12028	12028	12028		12025	12028	12028	12028	12028	
<i>reference</i>	Schnetzler71						Laul71	Ganapathy70				
<i>depth</i>	1.7 - 2.5 cm	13.2-14.4	18.9-19.7	31.2-32.2	37.2-38.2		1.7 - 2.5 cm	13.2-14.4	18.9-19.7	31.2-32.2	37.2-38.2	
SiO ₂ %												
TiO ₂												
Al ₂ O ₃												
FeO												
MnO												
MgO												
CaO												
Na ₂ O												
K ₂ O												
P ₂ O ₅												
S %												
<i>sum</i>												
Sc ppm												
V												
Cr												
Co							39					
Ni												
Cu												
Zn							6.1	1.5	5.1	5.4	4.3	(b)
Ga							3.9	2.7	5.2	5	5.2	
Ge ppb												
As												
Se							215	86	230	247	237	(b)
Rb	6.84	0.613	7.84	7.93	8.96	(c) 6		0.32	8.6	9	10.8	(b)
Sr	144.4	80.9	155.2	152.7	154.9	(c)						
Y												
Zr												
Nb												
Mo												
Ru												
Rh												
Pd ppb												
Ag ppb							28	301	140	3.6	7.2	(b)
Cd ppb							70	22000	53	48	49	(b)
In ppb							77	42	290	9	26	(b)
Sn ppb												
Sb ppb												
Te ppb							130	10	80	30	90	(b)
Cs ppm							0.25	0.023	0.35	0.36	0.34	(b)
Ba	389	44.9	442	463	518	(c)						
La												
Ce	90.2	10.2	112	109	121	(c)						
Pr												
Nd	57.2	7.82	70.1	68.4	78.2	(c)						
Sm	16.5	2.7	19.6	19.4	22.2	(c)						
Eu	1.74	0.73	2.03	1.97	2.025	(c)						
Gd	20.8	3.68	23.2	23.4	27.6	(c)						
Tb												
Dy	21.2	4.68	25.5	26.1	30	(c)						
Ho												
Er	13.1	2.83	14.9	15.5	17.1	(c)						
Tm												
Yb	12	2.77	14	14.2	16.1	(c)						
Lu	1.86	0.42	2.08	2.19	2.42	(c)						
Hf												
Ta												
W ppb												
Re ppb												
Os ppb												
Ir ppb							5.9	0.08	8.1	8.7	9.2	(b)
Pt ppb												
Au ppb							2.5	0.63	1.7	2.1	2	(b)
Th ppm												
U ppm												

technique: (a) IDMS, (b) RNAA, (c) IDMS

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